

User manual

DA14580 Development Kit

UM-B-014

Abstract

This document describes the Bluetooth Low Energy (BLE) Development kit based on DA14580-01. It helps customers to set up the hardware development environment, install required software and quickly start product development based with help of example source code.

Contents

Contents	2
Figures	2
Tables	3
1 Terms and definitions	4
2 References	4
3 Introduction.....	5
3.1 Hardware content.....	5
3.2 Web content	6
3.2.1 Software Development Kit content	6
3.2.1.1 Tools.....	6
3.2.1.2 SDK documents	6
3.2.1.3 SDK source code examples (created in Keil)	7
3.2.2 Schematics and PCB layout	7
3.3 Daughterboard	8
3.3.1 Block diagram	8
3.3.2 Schematics and layout.....	9
3.3.3 Configuring the daughterboard.....	12
3.4 Motherboard.....	12
3.4.1 Block diagram	12
3.4.2 Schematics and layout.....	16
3.4.3 Configuring the motherboard	17
3.4.4 Operation without measurement trigger (J10)	17
3.5 USB Dongle	18
3.5.1 Usage.....	18
3.5.2 Schematic	18
4 Quick start guide	19
4.1 Preparations.....	19
4.2 Installation of the tools and drivers	21
4.2.1 Keil.....	21
4.2.2 SEGGER Jlink driver	21
4.2.3 FTDI driver	22
4.3 Tera Term	22
4.4 Using the demo kit	23
4.4.1 Run an example on DA14580	23
5 Revision history	27

Figures

Figure 1 : Development Kit Daughterboard with WLCSP (top left), QFN40 (top right) and QFN48 (bottom)	8
Figure 2 : Schematics of the QFN40 Daughterboard	9
Figure 3: Silkscreen (left) and top (right) layout views of the QFN40 Daughterboard	10
Figure 4: Schematics of the WLCSP Daughterboard.....	10
Figure 5: Silkscreen (left) and top (right) layout views of the WLCSP Daughterboard	11
Figure 6: Schematics of the QFN48 Daughterboard	11

Figure 7: Silkscreen (left) and top (right) layout views of the QFN48 Daughterboard	12
Figure 8: Block Diagram of the Motherboard (Top View)	13
Figure 9: Jumper Settings for Buck Configuration	15
Figure 10 : Cable connection of measurement trigger to ground	17
Figure 11 : Pull down resistor to the gate of Q5 FET	18
Figure 12: USB Dongle Schematic	18

Tables

Table 1: Default Development Kit components	6
Table 2: SDK Examples	7
Table 3: Development Kit Daughterboard components	9
Table 3: Default Jumper Configuration	13
Table 5: Development Kit Motherboard components	15
Table 6: Motherboard configuration overview	16
Table 7: Default UART Connections for D/B & USB Dongle	21

1 Terms and definitions

BLE	Bluetooth Low Energy
CS	Chip Select
DK	Development Kit
EEPROM	Electrically Erasable Programmable Memory
FTDI	Quad-Flat No-leads
GPIO	General Purpose Input Output
QFN	Quad-Flat No-leads
OTP	One Time Programmable
SDK	Software Development Kit
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
USB	Universal Serial Bus
UTX	Quad-Flat No-leads
URX	Quad-Flat No-leads
URTS	Quad-Flat No-leads
UCTS	Quad-Flat No-leads
UCTS	Quad-Flat No-leads
UART	Universal Asynchronous Receiver/Transceiver
WLCSP	Wafer Level Chip Scale Packaging

2 References

1. DA14580, Datasheet, Dialog Semiconductor
2. UM-B-015, DA14580 Software Architecture, Dialog Semiconductor
3. DA14580 CB PXI QFN40 layout, Dialog Semiconductor
4. DA14580_CB_PXI_QFNP40, Dialog Semiconductor
5. DA14580_CB_PXI_WLCSP, Dialog Semiconductor
6. DA14580_CB_PXI_WLCSP_layout, Dialog Semiconductor
7. DA14580_MB_VB_layout, Dialog Semiconductor
8. DA14580 CB PXI_QFN48, Dialog Semiconductor
9. UM-B-005, DA14580 Peripheral Examples, Dialog Semiconductor
10. UM-B-010, DA14580 Proximity application, Dialog Semiconductor

3 Introduction

DA14580 is a Bluetooth low energy chip, working with extremely low power while providing world-class RF performance, a small footprint, and flexible peripheral configurations for a wide range of applications.

DA14580 development kit includes a set of hardware (e.g. development boards and debugger), a Software Development Kit (SDK) (e.g. development tools, source code examples documents and so on) along with documentation.

This document, as a user guide, helps customers to set up hardware/software development environment, install required software and quickly start product development based with help of example source code.

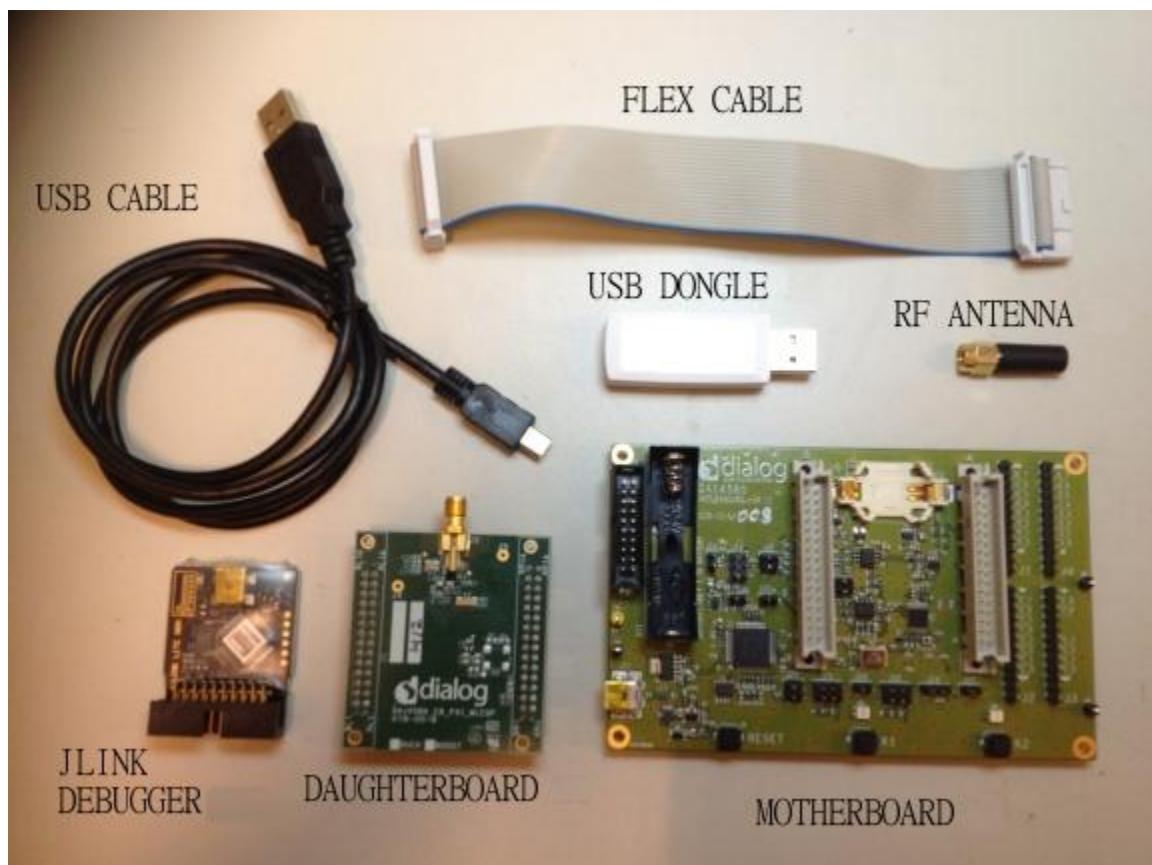
Web content can be downloaded at support.diasemi.com

Product information about DA14580 can be found at

www.dialog-semiconductor.com/products/short-range-wireless-technology/bluetooth-low-energy

3.1 Hardware content

The following picture presents the building blocks of the various the DA14580 DK Kits.



Figur1: DA14580 Development Kit

These are:

- Kit Components
 - DA14580 Motherboard
 - DA14580 Daughterboard WLCSP or DA14580 Daughterboard QFN40 or DA14580 Daughterboard QFN48
 - DA14580 USB Dongle

- Kit Peripherals
 - Segger Jlink Debugger
 - Flex Cable
 - USB Cable
 - RF Antenna
 - Battery – Type AAA
 - Battery – Coin Type

The aforementioned material is combined to provide the following products:

Table 1: Default Development Kit components

	KIT COMPONENTS					KIT PERIPHERALS					
KITS	MB	DB WLCSP	DB QFN40	DB QFN48	USB DONGLE	Segger JLink	Flex Cable	USB Cable	RF Antenna	Battery AAA	Battery Coin
MAIN KIT	1	-	-	-	1	1	1	2	1	1	1
WLCSP KIT	-	3	-	-	-	-	-	-	-	-	-
QFN40 KIT	-	-	3	-	-	-	-	-	-	-	-
QFN48 KIT	-	-	-	3	-	-	-	-	-	-	-

3.2 Web content

3.2.1 Software Development Kit content

3.2.1.1 Tools

Smart Snippets (a framework of PC based tools to control DA14580 development kit), consisting of

- Power Profiler : Real time current consumption measurement to for the DA14580 motherboard
- OTP Programmer: Tool for OTP memory programming
- UART booter : Tool for downloading hex files to DA14580 SRAM over UART
- SPI & EEPROM programmer: A tool for SPI & EEPROM flash programming
- Sleep Mode Advisor : Calculation tool to determine most optimal sleep modes

Connection Manager (a PC based software tool to control the link layer of the DA14580), with the following capabilities:

- Functional in Peripheral and Central role
- Set advertising parameters
- Set connection parameters
- Reading from Attribute database
- Perform production test commands

3.2.1.2 SDK documents

- UM-B-003, DA14580 Software development guide
- UM-B-004, DA14580 Peripheral drivers
- UM-B-005, DA14580 Peripheral examples
- UM-B-006, DA14580 Sleep mode configuration

- UM-B-007, DA14580 Software Patching over the Air (SPOTA)
- UM-B-008, DA14580 Production test tool
- UM-B-010, DA14580 Proximity application
- UM-B-011, DA14580 Memory map – scatter file
- UM-B-012, DA14580 Secondary bootloader
- UM-B-013, DA14580 External Processor Interface over SPI
- UM-B-014, DA14580 Development Kit
- UM-B-015, DA14580 Software architecture

3.2.1.3 SDK source code examples (created in Keil)

- **dk_apps.** This folder holds all the necessary folders needed for DA14580 application development.
 - **dk_apps\keil_projects\proximity**
The folder contains the following subfolders and in each one of them resides the respective project file:

Table 2: SDK Examples

Folder	Project File	Description
monitor_fe	fe_proxm_sdk.uvproj	Proximity Monitor (External processor)
reporter_fe	fe_proxr.uvproj	Proximity Reporter (External processor)
reporter_fh	fh_proxr_sdk.uvproj	Proximity Reporter (Integrated processor)
monitor_fe_usb	fe_usb_proxm_sdk.uvproj	Proximity Monitor (External processor) Version for USB dongle
reporter_fe_usb	fe_usb_proxr.uvproj	Proximity Reporter (External processor) Version for USB dongle

- **dk_apps\keil_projects\prod_test:** These folders include the source code of the production test firmware. Refer to DA14580_Production_Test_Tool.docx for more information how to build and use it.

For details, please read [9].

- **host_apps:** This folder holds the DA14580 PC applications:
 - **host_apps\windows\proximity:** The folder includes two Windows C++ applications, with each one acting as part of a proximity monitor and a proximity reporter application. They are placed in subfolders *monitor* and *reporter* respectively. For details, please read the *DA14580 Proximity Application Guide*.
 - **host_binaries\windows\proximity:** The folder includes two pre-compiled Windows executables which correspond to the C++ applications described right above and are included for user convenience.
 - **peripheral_examples:** The folder includes sample code of how to use peripheral blocks of the DA14580 (e.g. UART, SPI, I2C etc.) bundled to a demo-kit. For details, please refer to [10].
- **Tools**
 - **tools\prod_test\prod_test_cmds:** This folder includes the source code of the production test tool. Refer to DA14580_Production_Test_Tool.docx for more information how to build and use it.

3.2.2 Schematics and PCB layout

Schematics and PCB layout of the Motherboard, Daughterboard options and USB dongle are available on the customer support portal.

3.3 Daughterboard

3.3.1 Block diagram

The daughterboard comes in three different types depending on the type of package of the DA14580:

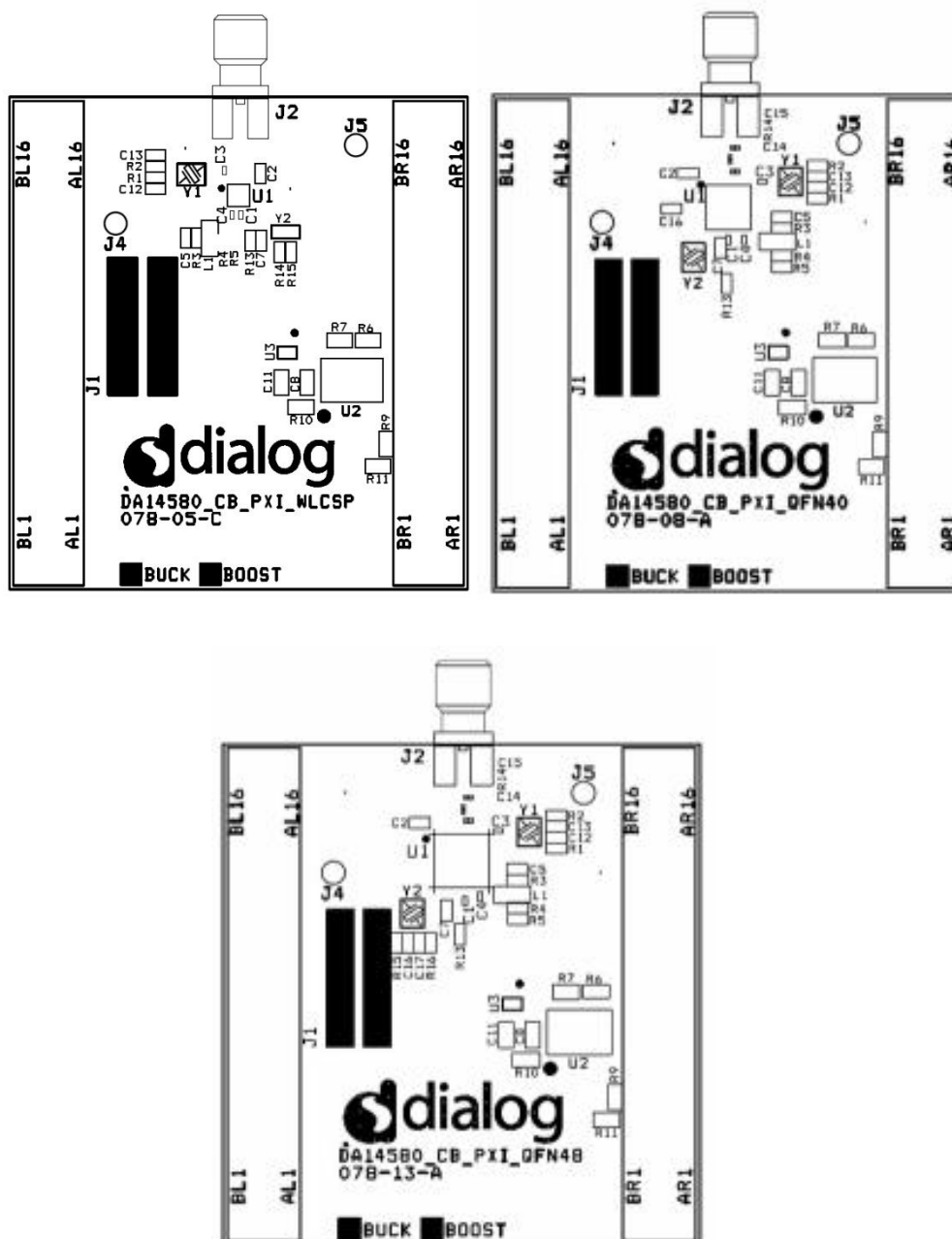


Figure 1 : Development Kit Daughterboard with WLCSP (top left), QFN40 (top right) and QFN48 (bottom)

The contents of the three boards are described in the table below:

Table 3: Development Kit Daughterboard components

Name	Description
Connectors	
J1	Socket to connect the Daughterboard onto the Motherboard
J2	SMA connector for the antenna
J4	Connected to Ground
J5	Connected to Ground
Units	
U1	DA14580 : QFN40 or WLSCP34 or QFN48 package
U2	CSX-750MB, 32MHz Crystal Oscillator (NOT POPULATED)
U3	TPS79718DCKR, LDO 10mA, 1.8V (NOT POPULATED)
Test Points	
TP1	Connects to P0_0. Used for RF internal measurements
TP2	Connects to P0_3. Used for RF internal measurements
TP3	Connects to P1_1. Used for RF internal measurements
TP4	Connects to P1_2. Used for RF internal measurements

3.3.2 Schematics and layout

The schematics for the PCB are depicted in the following figures:

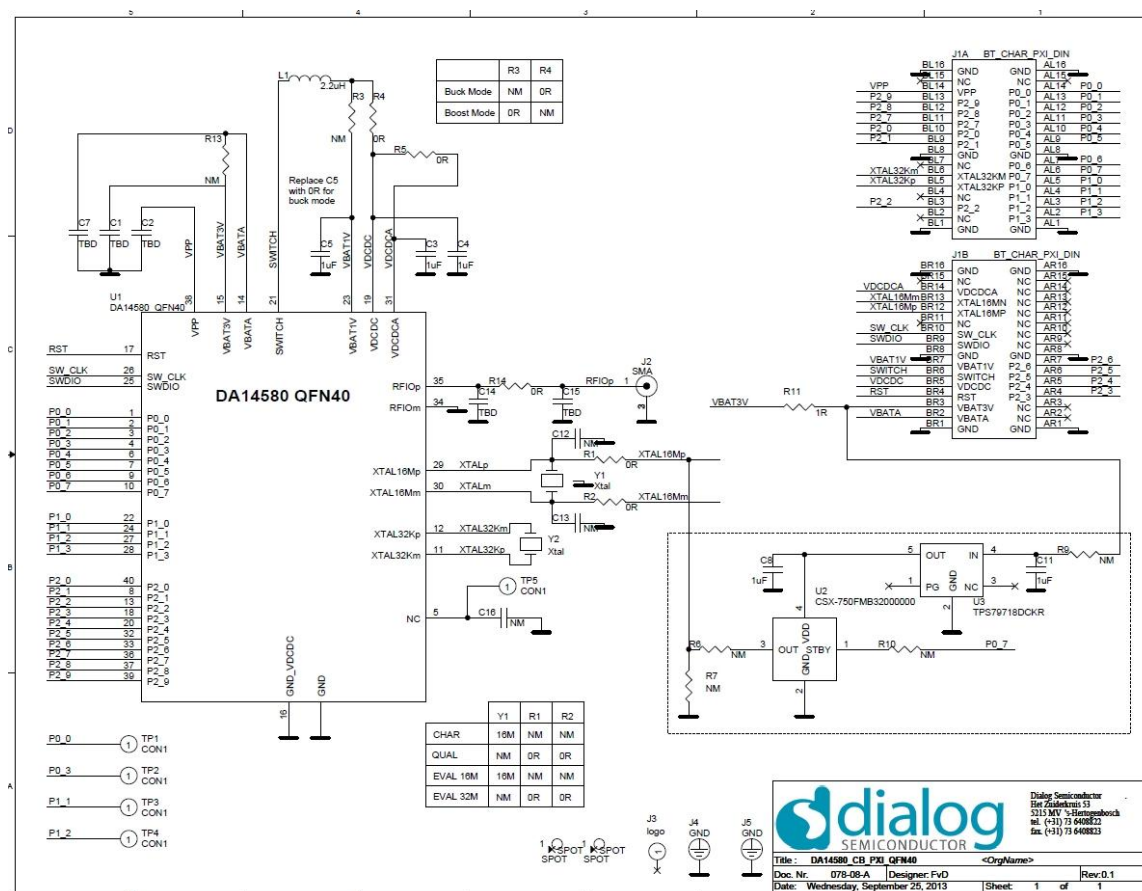


Figure 2 : Schematics of the QFN40 Daughterboard

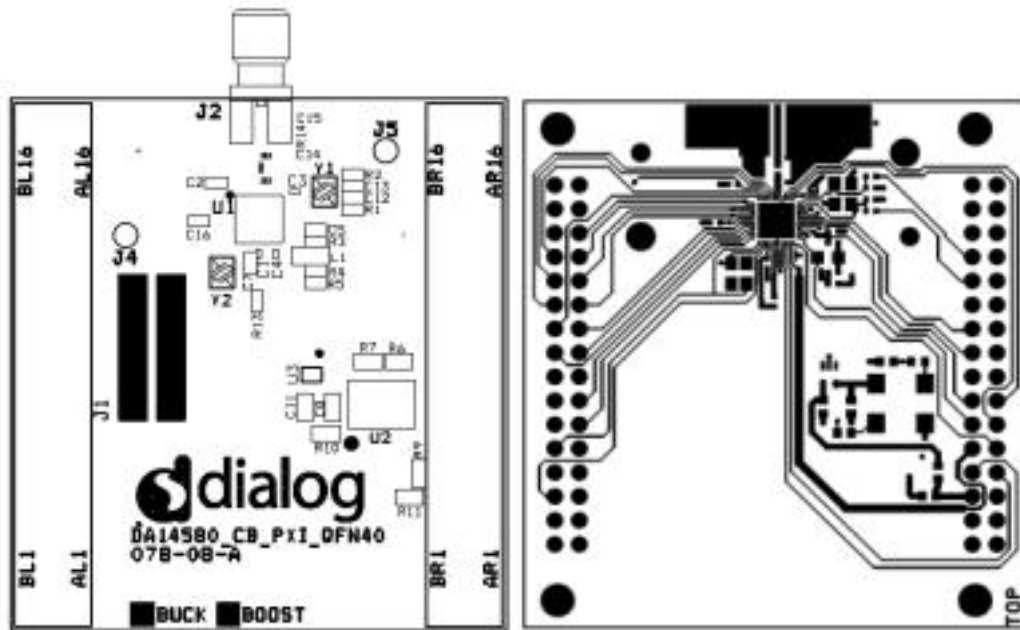


Figure 3: Silkscreen (left) and top (right) layout views of the QFN40 Daughterboard

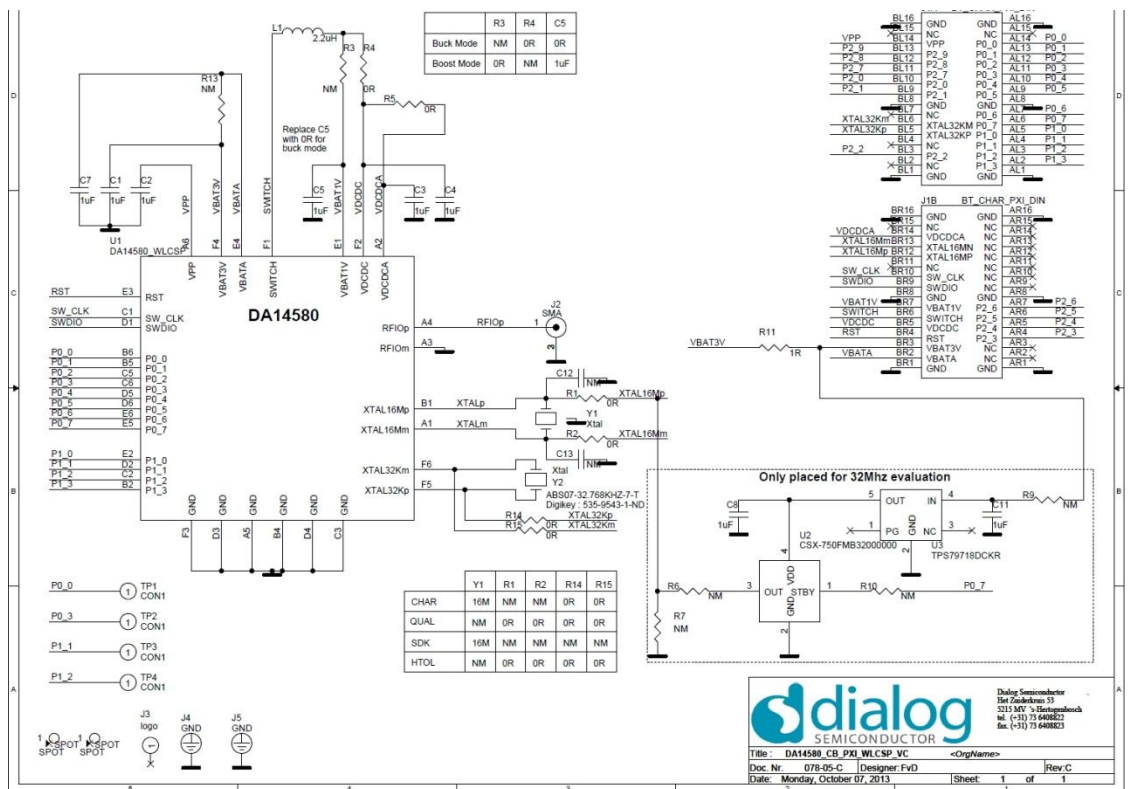


Figure 4: Schematics of the WLCSP Daughterboard

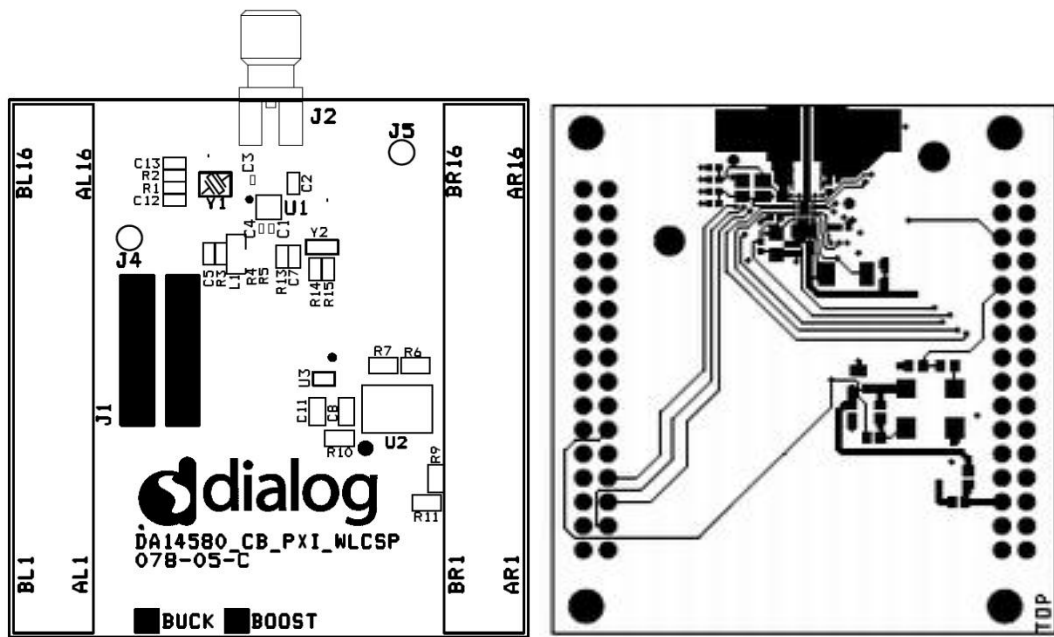


Figure 5: Silkscreen (left) and top (right) layout views of the WLCSP Daughterboard

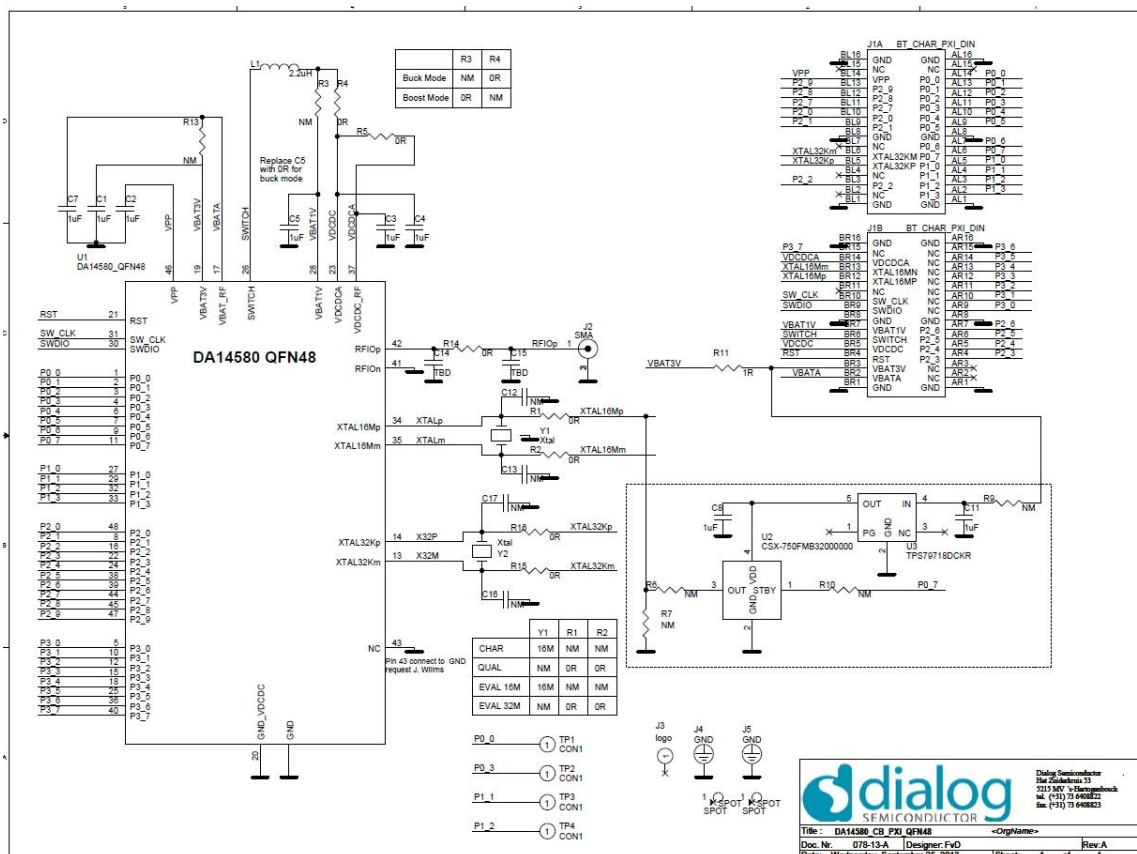


Figure 6: Schematics of the QFN48 Daughterboard

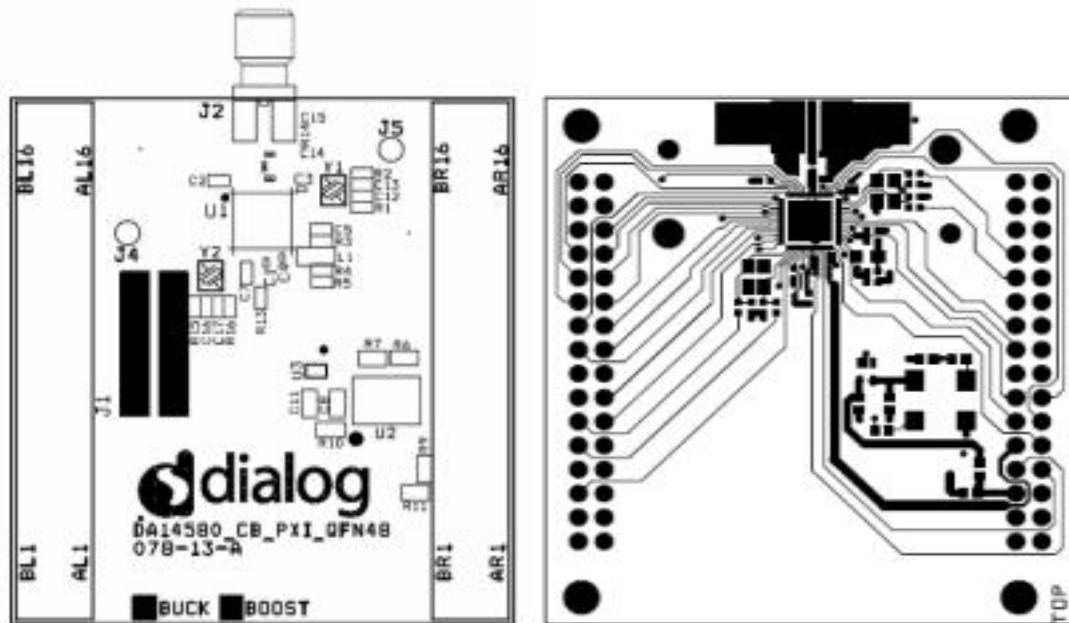


Figure 7: Silkscreen (left) and top (right) layout views of the QFN48 Daughterboard

3.3.3 Configuring the daughterboard

The daughterboard comes in 3 different flavours according to customer's requirements:

- A daughterboard with a QFN40 package
- A daughterboard with a QFN48 package
- A daughterboard with a WLCSP package

The board is shipped on request pre-configured as either Buck or Boost. Details for modification of the daughterboard to other than the default (shipped) configuration are provided in the *Hardware User Manual*.

3.4 Motherboard

3.4.1 Block diagram

The block diagram of the motherboard is displayed in the following figure:

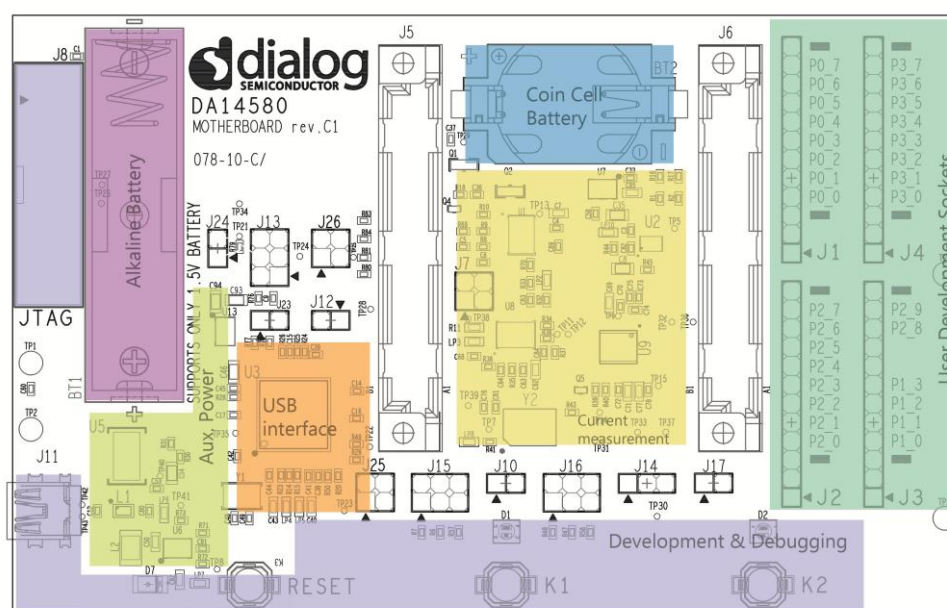
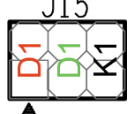


Figure 8: Block Diagram of the Motherboard (Top View)

Table 4: Default Jumper Configuration

Name	Color	Description
Connectors		
J1	Green-Blue	Socket to connect an external board for Bluetooth Smart applications
J2	Green-Blue	Socket to connect an external board for Bluetooth Smart applications
J3	Green-Blue	Socket to connect an external board for Bluetooth Smart applications
J4	Green-Blue	Socket to connect an external board for Bluetooth Smart applications
J8	Lila	JTAG header. Complies to the J-link standard format
J5	White	Socket for the Development Kit, Daughterboard
J6	White	Socket for the Development Kit, Daughterboard
J11	Lila	Mini-USB connector
J12	White	Connects P1_2 pin to the enable gate of the VPP voltage. To be used for programming the OTP.
J13	White	Controls the power source for the power measurement circuit: BT1 (alkaline), BT2(coin cell) or VCC_IN (LDO)
J14	White	Selects power source for the DA14580: either coin or alkaline
J15	 White	Connects: P1_1 with the K1 button. P1_2 with the D1 led (green). P1_3 with the D1 led (red).
J16	White	Connects: P0_6 with the K2 button P0_7 with the D2 led (green).

		P1_0 with the D2 led (red).
J17	White	Connects the RESET button to the VBAT power. To be used as a soft reset on the FT2232HL chip.
J10	White	Connects GPIO for measurement trigger
J23	White	Selects 3.0/1.5 Volt output for the LDO.
J24	White	Shorts the 100ohm resistor at the LDO output
J25	White	Connects UART TX/RX to the default GPIOs
J26	White	Connects UART RTS/CTS to the default GPIOs
Units		
U1	Yellow	Current to Voltage Conversion OpAmp
U2	Yellow	OpAmp for the ADC voltage reference
U3	Orange	FT2232HL, Dual Serial to USB bridge
U5	Green	Low Dropout Regulator for the VBUS power
U6	Green	Step-up regulator, generates 6.8 Volts
U7	Yellow	Low noise Low Dropout Regulator to create silent 5V
U8	Yellow	Differential OpAmp for the conversion circuit
U9	Yellow	Analog to Digital Converter
Test Points		
TP1	C/V Converter	output suitable for Oscilloscope
TP2	GND	ground point
TP3	GND	ground point
TP4	GND	ground point
TP5	P0_5	option for crystal calibration
TP7	3.3V	power supply rail
TP8	+6.8V	power supply rail
TP9	5.0V	power supply rail
TP11	VINN	output of differential converter
TP12	VINP	output of differential converter
TP13	5.0VA	power supply rail
TP14	27MHz	oscillator
TP15	VREF	voltage reference
TP16	Bumpon 3M SJ61A1	Mechanical Part
TP17	Bumpon 3M SJ61A1	Mechanical Part
TP18	Bumpon 3M SJ61A1	Mechanical Part
TP19	Bumpon 3M SJ61A1	Mechanical Part
TP20	Bumpon 3M SJ61A1	Mechanical Part

TP21	VCC_IN	3.0V/1.5V, LDO or battery
TP22	UTX	UART Transmit
TP23	URX	UART Receive
TP24	UCTS	UART Clear to Send
TP25	URTS	UART Request to Send
TP26	SWDIO	JTAG input/output
TP27	SWCLK	JTAG clock
TP28	VPP_EN	VPP enable
TP29	VPP	VPP (6.8V when VPP_EN is high)
TP30	RST	reset
TP31	AD_DIS	analog trigger control
TP32	GND	ground point
TP33	GND	ground point
TP34	GND	ground point
TP35	VREG	FT2232H regulator (1.8V)
TP36	VBAT1V	voltage input for boost cfg
TP37	VBAT3V	voltage input for buck cfg
TP38	VBAT	DA14580 I/O voltage
TP39	AD_DO	SPI data out (low if AD_DIS is high)
TP40	VBUS	USB VBUS (connect a USB cable)
TP41	GND	ground point
TP42	USBDM	USB signal (neg)
TP43	USBDP	USB signal (pos)
Buttons		
RESET	Lila	Reset button. Resets all devices on board
K1	Lila	Connects to P1_1 (J15[5,6] should be shorted)
K2	Lila	Connects to P0_6 (J16[5,6] should be shorted)

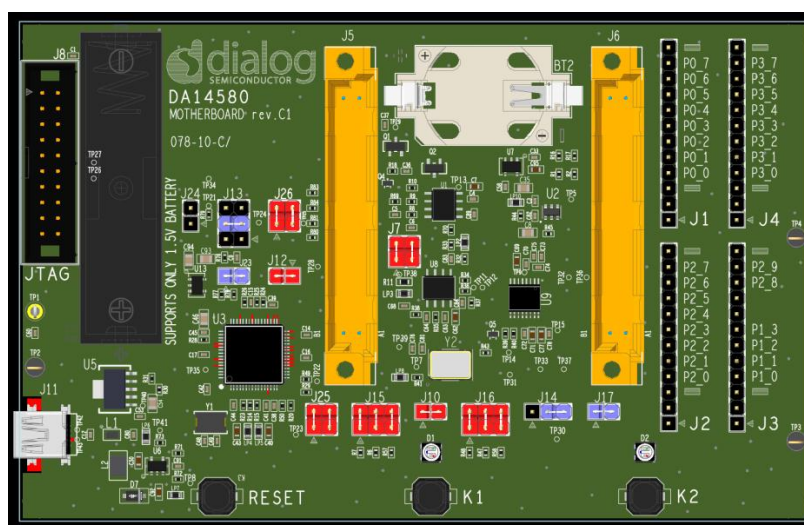


Figure 9: Jumper Settings for Buck Configuration

Note 1 The jumpers depicted with red color are possible sources of leakage

Table 5: Development Kit Motherboard components

Jumper Block	Description	Default State
J7	Power measurement input	populated (1-2,3-4)
J10	Power measurement trigger	populated
J12	VPP programming voltage enable	populated
J13	Power input select	populated (3-4)
J14	Daughterboard power input select	populated (2-3)
J15	Key1, LED1 connection	populated

J16	Key2, LED2 connection	populated
J17	RESET power source	populated
J23	LDO voltage selection	populated
J24	LDO output resistor bypass	not populated
J25, J26	UART connection	populated (1-2,3-4)

3.4.2 Schematics and layout

For the schematics and layout of the motherboard please refer to the respective documents in the portal.

Table 6: Motherboard configuration overview

#	Description	Related Board Items	What to do
1	Enable P1_2 to activate the 6.5V on the VPP pin for the OTP programming	J12	Apply Jumper to enable feature
2	Power supply of the measurement circuit	J13	Jumper at 1-3: power from BT1 (<i>Boost Configuration</i>) 3-5: power from BT2 (<i>Buck Configuration</i>) 3-4: power from U13 (<i>default – 3.0V</i>)
3	DA14580 power supply	J14	Jumper at 1-2: power from Alkaline (<i>Boost Configuration</i>) 2-3: power from Coin Cell (<i>Buck Configuration - default</i>)
4	General Purpose LEDs/Buttons	J15	Jumper at 5-6: P1_1 connects to K1 button 3-4: P1_2 connects to D1 LED 1 1-2: P1_3 connects to D1 LED 2
5	General Purpose LEDs/Buttons	J16	Jumper at 5-6: P0_6 connects to K2 button 3-4: P0_7 connects to D2 LED 1 1-2: P1_0 connects to D2 LED 2
6	Reset	J17	Apply Jumper to allow RESET button to drive a reset
7	Selects 1.5 / 3 V	J23	Selects the voltage output of LDO (U13) that provides power to DA14580 daughterboard through J13 (jumper on 3-4) Placed: 3.0V output Not placed: 1.5V output
8	Shorts the 10 Ohm resistor at the LDO output	J24	Do not apply Jumper.
9	Connects UART TX/RX to the default	J25	Apply Jumpers.

	GPIOs		
10	Connects UART RTS/CTS to the default GPIOs	J26	Apply Jumpers.
11	Connects GPIO for measurement trigger	J10	Apply Jumper.

3.4.3 Configuring the motherboard

The motherboard can be configured with use of Jumpers that enable/disable various features. An overview is presented in the Table 4.



Figure 10 : Cable connection of measurement trigger to ground

3.4.4 Operation without measurement trigger (J10)

When the board is not required to use the measurement trigger function, jumper J10 can be removed. This jumper when placed connects GPIO P1_3 to the gate of Q5 and by issuing a high level it can create a signal that the PowerProfiler application detects and places a marker on the captured waveform. This can be useful for software debugging. Any other GPIO from 580 can be used by connecting a wire to J10, but if the jumper is not placed at all, it may pick-up noise (from EMI etc.) and produce false triggers.

The issue can be avoided by connecting the gate of Q5 to ground (Figure 5-10) or – a more permanent solution – by adding a pull down resistor (100 kΩ), as shown on Figure 5-11. The resistor keeps the gate low when it is left unconnected.

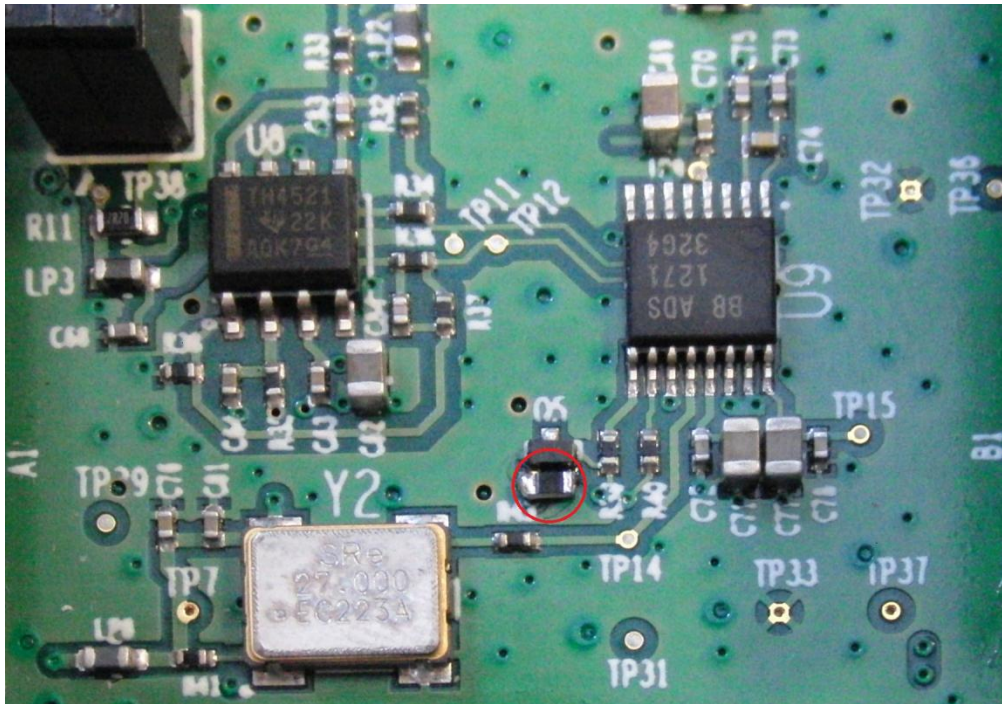


Figure 11 : Pull down resistor to the gate of Q5 FET

3.5 USB Dongle

3.5.1 Usage

The Development kit comes also with a standard USB BTLE Adapter (or Dongle). For more info on its usage please refer to the UM-B-010.

3.5.2 Schematic

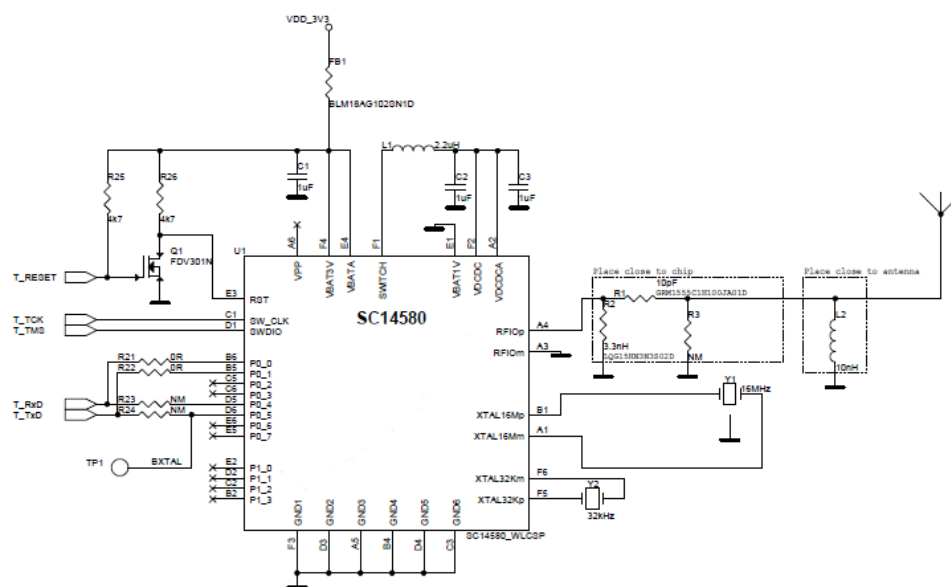
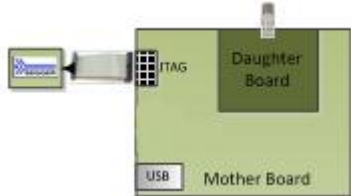
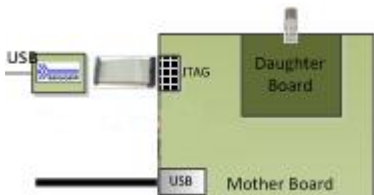


Figure 12: USB Dongle Schematic

4 Quick start guide

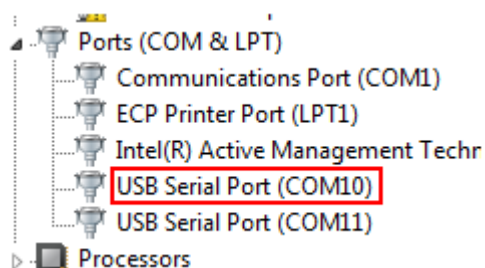
4.1 Preparations		
This chapter shows the user how to quickly set up the software development environment of the BLE (Bluetooth Low Energy) demo		
4.1.1	Stack the daughter board on top of the mother board.	
4.1.2	Connect Jlink debugger to the mother board with flex cable.	
4.1.3	Connect Jlink debugger to a PC with a mini-USB-to-USB cable.	
4.1.4	Connect the USB cable.	

4.1.5

Normally the UART connection is supplied by the USB cable. If you want to use an external serial adapter, remove the jumpers from headers J25 and J26 and connect the appropriate external cable to either the default pins or whatever GPIOs you want to use.

However, the use of other pins is **optional**, while the default is to use the virtual COM port over USB.

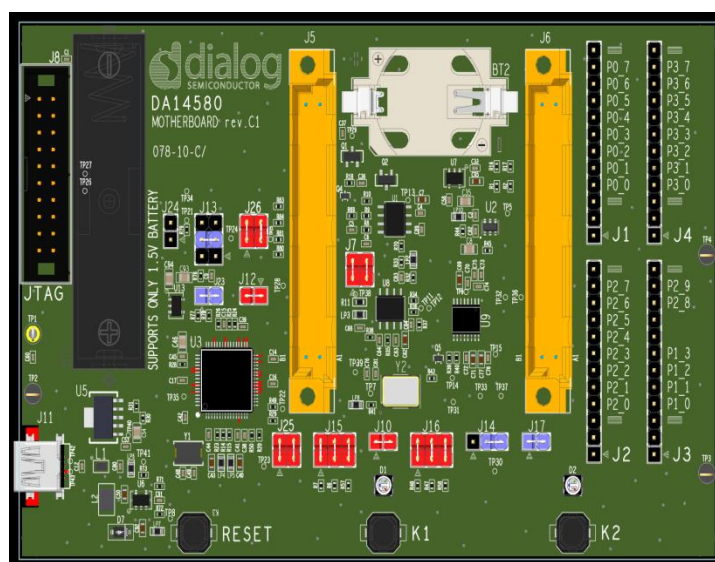
The virtual COM port number assigned is always the first one, as is seen at the example *Windows Device Manager* screenshot (here COM10).



4.1.6

Make sure that the jumper configuration on your M/B is the same as the side figure (*Buck configuration*).

For more configuration options refer to *Table 5*



DAUGHTERBOARD		
Signal Name	FTDI Pin Number	DA14580 GPIO
UTX	17	P0_4
URX	16	P0_5
UCTS	18	P0_2

URTS	19	P0_3
USB DONGLE		
Signal Name	ATMEL AVR32 Pin Number	DA14580 GPIO
UTX	D10	P0_4
URX	D9	P0_5

Table 7: Default UART Connections for D/B & USB Dongle

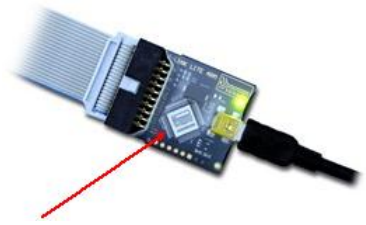
4.2 Installation of the tools and drivers

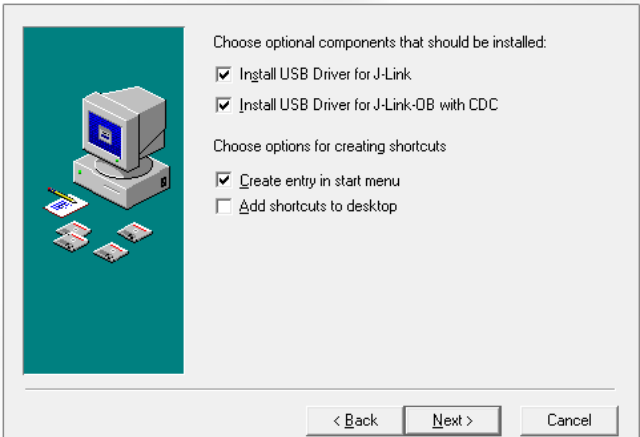
To install the Software development environment please follow the steps below.

4.2.1 Keil

4.2.1.1	Download and install Keil MDK-ARM uVision IDE. uVision ver.4.0 and ver. 5.0 are supported.	Keil: https://www.keil.com/download/product/ Starters Guide: http://www.keil.com/uvision/ide_ov_starting.asp
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4.2.2 SEGGER Jlink driver

4.2.2.1	Download and install the Jlink software & documentation pack for Windows. <i>Please note that your SEGGER Jlink serial number is required for downloading.</i> <i>This can be found on the plugin module as shown below</i> 	 J-Link software & documentation pack for Windows Installing the software will automatically install the J-Link USB drivers. It also software can be installed on the same PC without problems; they will co-exist. The package contains: • GDB Server - Support for GDB and other debuggers using the same • J-Link Configurator - Free utility to manage a various number of J-Link • J-Link Commander - Simple command line utility, primarily for diagnosis • J-Link Remote Server - Free utility which provides the possibility to • SWO Viewer - Free tool which shows terminal output of the target • J-Mem - Memory viewer. • J-Link DLL Updater - Allows to update 3rd party applications which • Free flash programming utilities - Simple command line utilities which • USB driver (Includes driver for J-Links with CDC functionality). • Manuals: UM08001 (J-Link User Guide), UM08003 (J-Flash User Guide) (Flasher ARM User Guide). • Release notes for J-Link DLL, J-Flash, J-Link RDI DLL. • J-Flash, including sample projects for most popular eval boards. • J-Link RDI - Support for ARM RDI standard. Makes J-Link compatible  Download Software and documentation pack for Windows http://www.segger.com/jlink-software.html
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4.2.2.2	In order to have the USB Dongle properly recognised by Windows as a J-Link device, you have to install the driver with the settings shown in the side figure. At the end of the installation, please tick the IDE (Keil MDK Vxx) that you are using.	 The following 3rd-party applications using JLinkARM.dll have been found: ☐ IAR Embedded Workbench for ARM (DLL V4.58a in "C:\Program Files") ☒ Keil MDK V4.70 (DLL V4.66a in "C:\Keil\ARM\Segger") Select All Select None
4.2.3 FTDI driver		
4.2.3.1	The Development Kit uses the D2xx driver. For Windows, this driver is part of the Combined Driver Model (CDM) driver. (It is recommended that the latest driver available from the page below is used.)	USB Drivers: http://www.ftdichip.com/Drivers/D2XX.htm Installation Guide: http://www.ftdichip.com/Support/Documents/InstallGuides.htm
4.3 Tera Term		
4.3.1	Download and install Tera Term on your PC.	Tera Term: http://en.sourceforge.jp/projects/ttssh2/releases/

4.4 Using the demo kit

Follow these steps to easily create a working demo kit.

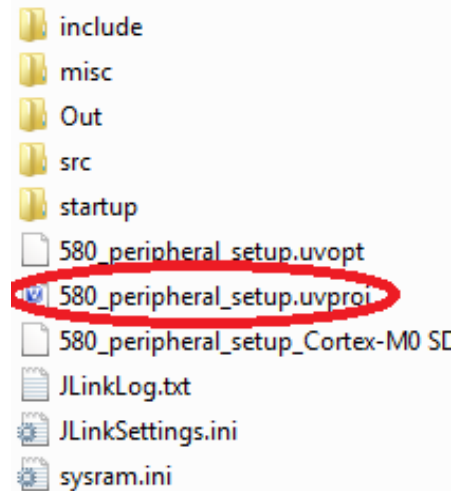
4.4.1 Run an example on DA14580

4.4.1.1

After you download SDK at support.diasemi.com you can find a source code example in example directory called "peripheral_examples\peripheral_setup".

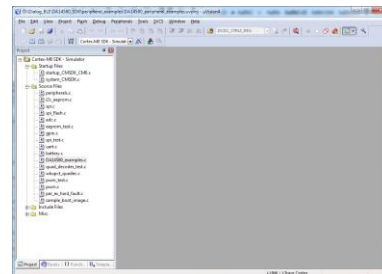
Double click "580_peripheral_setup.uvproj", as shown in the image to the right.

Name



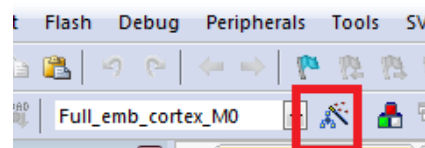
4.4.1.2

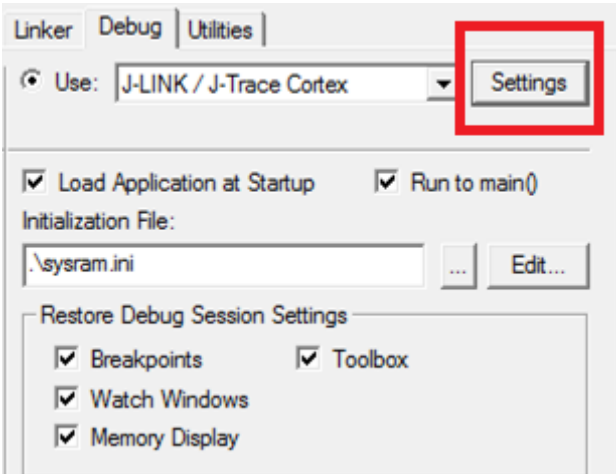
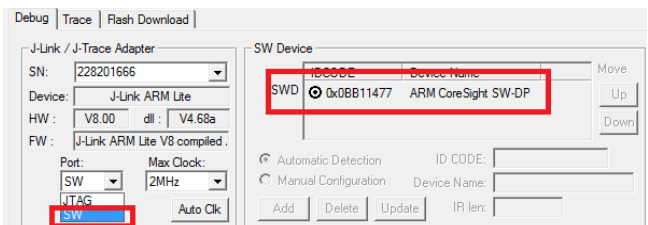
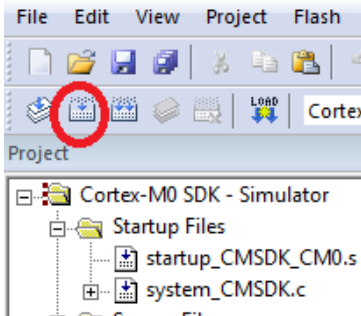
The development environment should look like this when the project is opened with Keil.

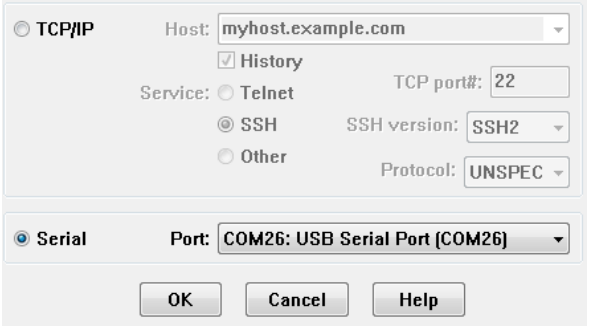
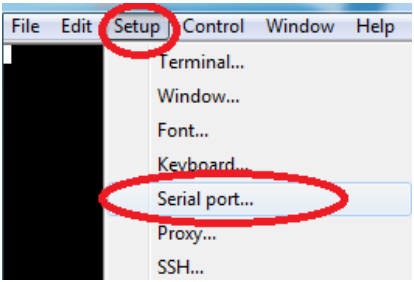
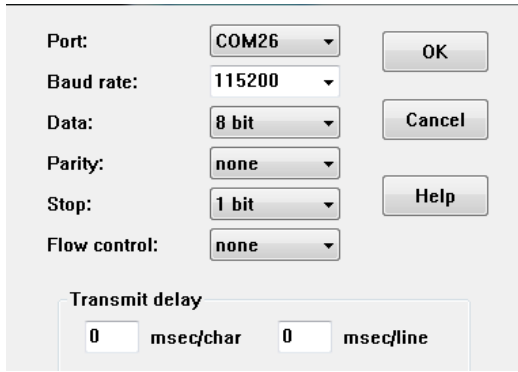
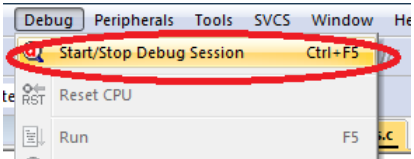
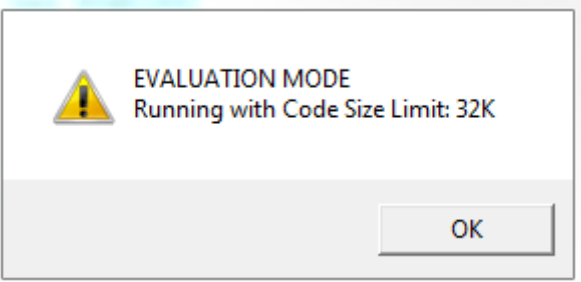


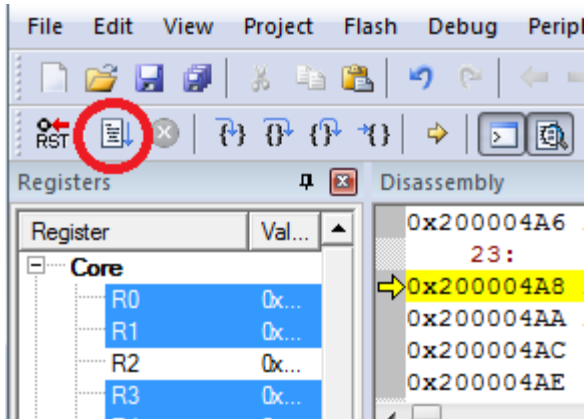
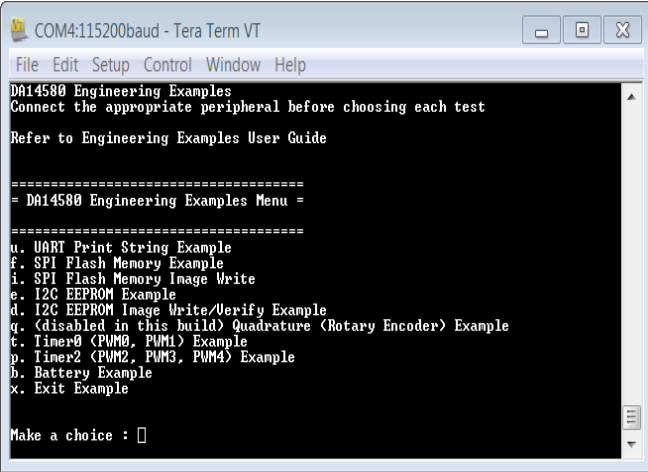
4.4.1.3

Click on the "Target Options" button



4.4.1.4	Make sure "J-LINK/J-Trace Cortex" is selected as shown and the initialization file field is set correctly to ".\sysram.ini".	
4.4.1.5	Click on the "Setting" button above to make sure the SW Device has been detected correctly.	
4.4.1.6	Click "OK" to save the settings.	All settings have been saved properly now, and you can continue to build the example.
4.4.1.7	Build the project by pressing "F7" key, or click the build button as shown in following picture	
4.4.1.8	Make sure you have a UART connection between your PC and a mother board, as shown in 6.1.5. Check the "COM" number on you PC.	Go to the Windows Control Panel → Administrative Tools → Computer Management → Device Manager → Ports → USB Serial Port # (connect or disconnect to see the COM port of that module)
4.4.1.9	Open the Tera Term serial terminal on you PC.	

4.4.1.10	Open Tera Term and choose a COM port, which you have found in step 3, and click OK	
4.4.1.11	Choose Setup->Serial port to configure the Baud rate etc.	
4.4.1.12	Set "Baud rate" to 115200, "Data" to 8 bit, "Parity" to None, "Stop" to 1 bit and "Flow control" to none. Click OK. Now we have a properly configured UART terminal on our PC.	
4.4.1.13	Go back to Keil Project. In the menu bar, select Debug->Start/Stop Debug Session.	
4.4.1.14	A dialog window pops up, like the one on the right. Please click "OK"	

4.4.1.15	Press F5 key or click execution button as shown in following picture, to start code execution.	
4.4.1.16	Then you can see a <i>hello</i> message on your UART terminal screen. That means you have successfully programmed and started the peripheral program on DA14580 Demo board. The <i>peripheral_setup</i> demo consists of a small suite of tests that encompasses some of the most commonly used peripherals such as I2C EEPROM, SPI Flash, Rotary Encoder, audio buzzer etc. For more detailed info and technical details please refer to the <i>UM-B-005: DA14580 Peripheral Examples</i> as well as the source code of the <i>peripheral_setup</i> demo.	

5 Revision history

Revision	Date	Description
1.0	18-Mar-2014	Initial version for DA14580-01

Status definitions

Status	Definition
DRAFT	The content of this document is under review and subject to formal approval, which may result in modifications or additions.
APPROVED or unmarked	The content of this document has been approved for publication.

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